Just Buy It At Radio Shack!

Myths About COTS in Military Electronic Applications

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Today's procurement problems were yesterday's procurement solutions."

—Senator Sam Nunn

How can we preserve the technical superiority of U.S. forces at a price we can afford? One innovative approach is to use Commercial Off-the-Shelf (COTS) technology rather than develop unique systems from the ground up. Especially in the electronics industry, this approach seems to offer "low hanging fruit" ready for us to pluck. Many fine articles have been written on the potential advantages of a COTS approach. I am a strong advocate of COTS.

We must, however, recognize and manage some new risk areas that are built into the COTS approach. The risk areas aren't well known because the approach is not traditional. This article will address four common myths and misconceptions of COTS in military electronic applications.

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Why Use COTS?

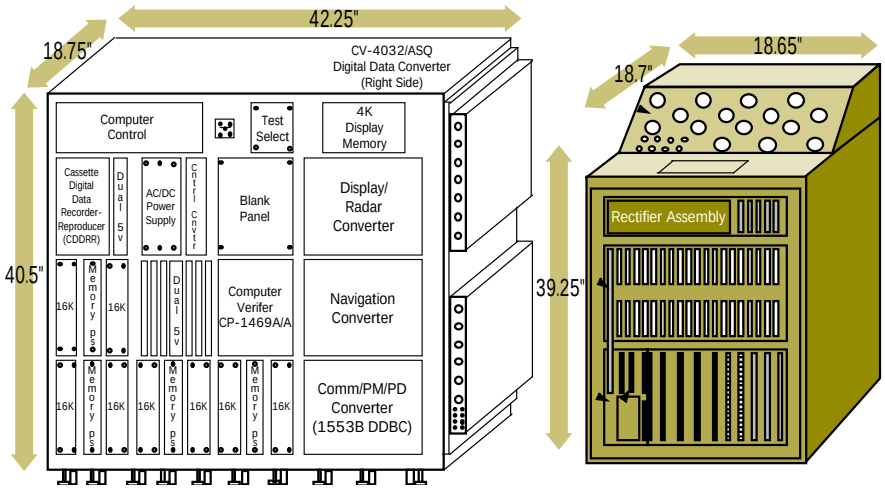
Simply put, the DoD cannot afford to do business as usual any more! We have chosen a strategy of high technology rather than superior numbers for our weapons systems. An entire defense industry emerged after World War II to support this approach.

With the perception of today's diminished threats, support for the DoD budget has declined dramatically. The continued rise of mandatory entitlement spending places ever increasing pressure on the dwindling remainder of discretionary spending, particularly the defense budget. Procurement of new systems has been especially hard hit, so the entire fleet of weapons systems is aging. End strength has been cut everywhere, which means the remaining systems are asked to do more. DoD demand was a significant market force in the electronics industry for many years, but that has also declined. For example, all government purchases of semiconductors are only 1.3 percent[1] of the total $100 billion market. Industrial research and development (R&D) spending has risen rapidly, but the DoD's spending has been declining since 1985. Today, DoD R&D spending is less than half that of commercial industry.[2] Defense industrial firms merge and disappear daily. Government facilities for repair and rework are also closing.

The threat today is not a monolithic, backward enemy that we at least understood well. Instead, it is unpredictable, geographically dispersed,

Illustration courtesy Northrup Grumman

Figure 1. Results of MCU Program Using MCOTS



and technically well armed. The spread of weapons of mass destruction and the tendency toward terrorism place a great burden on rapid surveillance, analysis, and concentration of firepower.

As a result, we need a huge bang for the buck! Short of remobilization, we have no choice but to take advantage of the dynamic advances in commercial product development. This is especially true in the rapidly advancing electronics industry.

HAWKEYE 2000 IS THE LATEST GENERATION E-2C HAWKEYE AND IS PLANNED FOR FLEET INTRODUCTION IN CALENDAR YEAR 2000.

COTS and the E-2C Hawkeye

In this article, I'll discuss some myths that impacted mission computer applications for carrier-based aircraft, specifically the E-2C Hawkeye. It's a good case to use because the Hawkeye Program is representative of many applications: a mix of obsolete and state-of-the-art in a very demanding environment.

The E-2C is the U.S. Navy's Airborne Early Warning aircraft. The "C" model has been in nearly continuous production since 1971, and is currently in production by the Northrop Grumman Corporation. The weapons system is a sophisticated sensor array which observes and classifies six million cubic miles of airspace every 10 seconds, displays its findings to three weapons systems operators, and transmits results on many data links. Like all carrier-based aircraft, weight, volume, and performance are at a premium.

In order to regain weight and volume margins for other sensor improvements, the Mission Computer Upgrade (MCU) program was begun in 1992. PMA-231 chose a Modified Commercial Off-the-Shelf (MCOTS) approach to replace the antiquated existing computer. MCOTS could also be called "ruggedized" COTS, i.e., modified only as required to meet environmental needs. The goal was to replace the old mission computer with a state-of-the-art, open architecture system that could ride along the commercial development wave (Figure 1).

Some COTS Myths

Just when we think we have found the "solution" to all of DoD's problems, reality confounds us. Recognizing some COTS mythologies will help you avoid a bad decision based on a well-intentioned, but wrong-headed approach to COTS.

Myth #1: If you can't buy it at Radio Shack, you aren't using a COTS approach.

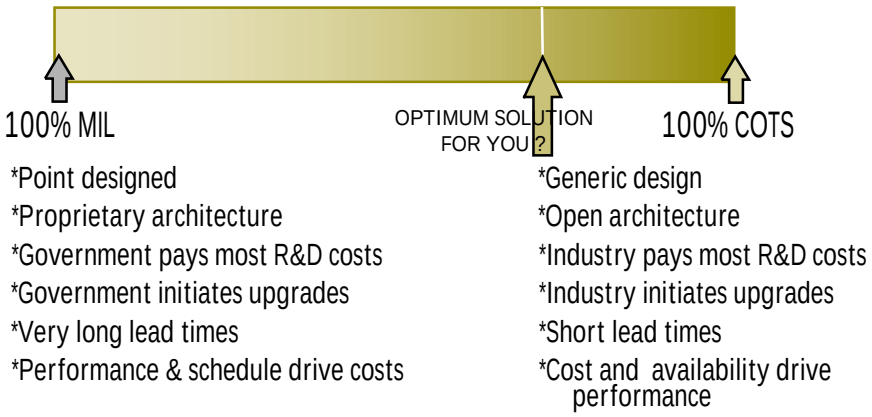
This inevitable argument really misses the whole point of the COTS approach. It means we have to remind ourselves that COTS is a means to an end, not an end itself. The desired end game is to "preserve the technological superiority of U.S. forces at an affordable cost."[3] Consider the "COTS Meter" shown in Figure 2.

The old approach would have been to start the design from the 100-percent military unique point, and not consider alternatives regardless of cost. Now there are some equally zealous types who only want 100 percent COTS, and won't consider modifications. The common-sense approach starts with the right side of the "COTS Meter" and very carefully moves left to achieve the desired total performance. In DoD, the primary reason for "moving to the left" is to meet environmental demands of warfighting; such as extreme vibration, shock, salt fog, and thermal requirements.

Myth #2: COTS won't meet the warfighter's requirements.

This argument shows a lack of understanding about requirements. Requirements are a total package of cost, schedule, and performance. In the past, performance and schedule were

Figure 2. The COTS Meter



emphasized, usually at the expense of life-cycle cost. Today, cost is an independent variable, and it often determines the performance you can have.

However, some valid military performance requirements are often severe and distinct from commercial requirements. Commercial equipment would not be intentionally designed for such regimes; overdesigning the product would make it cost prohibitive for the commercial market. An example are the shock requirements to survive an aircraft carrier landing. On the E-2C, COTS circuit boards are sheltered using a shock-mounted enclosure.

In some cases, the customer's requirements may have to be challenged. Does the mission system really need to operate at -50° C (the traditional MIL-SPEC requirement) or would -20° C suffice? Is the customer really willing to escalate program costs and schedule to gain that last bit of performance at the edge of the thermal envelope? An alternative could be to increase spares to account for more projected failures. Users, developers, and independent test agencies need to see requirements as a total package. They should be willing to buy into tradeoffs for total value.

Myth #3: COTS will offer huge savings (and we'd like to begin collecting now, if you please).

It certainly does seem true that a COTS approach can save money and time *during* development. If you upgraded your home computer from a 486 to a Pentium processor, you only paid a very small price for huge performance gains. Your cost avoidance is at least $200 million dollars (the cost of Pentium development), and schedule avoidance is three years.[4] Moreover, you get the low unit cost of a processor sold in mass quantities. In the case of the E-2C MCU, we also reap cost benefits through lower recurring costs, *but most especially*, from the commercial availability of software development systems (e.g., Ada compilers). Additionally, the processor speed of the prototype MCU has increased from 275 MHz to 375 MHz *at no cost to the U.S. Navy*! Great stuff!

But what about hidden costs? Squeezing the program manager for early "savings" from using COTS may actually result in added program cost later. We won't know until well into the Operations and Support (O&S) phase of projects that are just now in development. Most of a program life-cycle cost (80-85 percent) is generated in the O&S phase; this has been validated for many electronic and software projects.[5] What if a computer vendor decides to move on to a more lucrative product line in 18 months, and your now-obsolete processor has no upgrade path? Upgrades may be available (e.g., 486 to Pentium), or you could be left with a COTS dinosaur. With the consolidation of vendors and the diminished market share of DoD, your program may be left with a huge unprogrammed cost and a monopoly supplier. The privatization of government support facilities, especially software support activities and depots, will add to this dilemma.

Success or failure will depend upon your ability to choose a product line with broad commercial appeal. Vendors should be able to show solid and potential orders. They should be able to articulate a business strategy that includes several generations of upgrades. And finally, they should discuss their plans for solving your potential obsolescence problems. These are ways to partially mitigate risk, but it is premature to assume large program savings just because the start-up costs may be lower.

Myth #4: Commercial design is always more reliable than military equipment.

You would be hard-pressed to find commercial hardware that is more reliable than military gear in a military environment. With DoD mission critical software, there is always extensive testing and verification performed—dropping bombs in the wrong place is obviously disastrous. On the other hand, the reliability of commercial hardware and software is determined more by market forces in pure COTS applications than in a traditional MIL-SPEC system. A commercial banking system will demand a high degree of reliability, a graceful degradation capability, and sophisticated multi-level security. A financial management system for home use requires none of these, and you wouldn't want to pay for them. But, both COTS systems presumably satisfy their customers, or else the "invisible hand" of the competitive market causes a correction!

Of course, we don't have powerful market forces in defense procurement—we often have one buyer and one/few sellers. A careful examination of COTS offerings for the E-2C showed some major shortfalls in reliability, and in the amount of testing to "guarantee" performance. This brought on a very serious "COTS

Meter" discussion. Typical commercial Built In Test for hardware operates at a 90- to 95-percent rate of fault isolation, less than traditional MILSPEC but perhaps acceptable depending on the application. There aren't any equivalent reliability metrics yet for commercial software because the market doesn't demand them. Commercial software confidence levels (e.g., no "bugs," how long between "crashes") aren't usually known, postulated, specified, or advertised. You may be quite impressed with the perceived reliability of your desktop computer, but remember that it is optimally designed to operate in a benign environment, and the real consequences of failure are low. Questions to consider are:

- Is this good enough for a *mission critical system*?
- How much will you be willing to pay to gain the performance increase?
- How far "left on the COTS Meter" should you drive the hardware and software to get this, and what are the long-term cost implications?

Much has been written on the potential merits of COTS technology in military applications. *I'm an enthusiastic supporter of COTS, but temper my enthusiasm with reality.* An aspirin for a headache is good–but a whole bottle at one sitting is deadly! We are breaking new ground with the COTS approach, and I suggest we tread carefully. My specific conclusions and recommendations follow:

- COTS means different things to different people. Resolve up front what it means to your design team, your contractors, and the decision authority.
- Remember the desired end: maintaining the technological edge of our fighting forces at an affordable price. COTS may offer a means to an end–but it isn't an end itself.
- There are many ways to use COTS. You need to define where you are on the COTS Meter.
- COTS may meet your requirements, but it may not. Be willing to go for the optimum of cost, schedule, and performance. Challenge requirements.
- It is unknown if COTS will offer the "huge savings" promised, if life-cycle costs are considered. Choose an approach that has broad commercial appeal. Don't choose the "Betamax" approach over "VHS" just because Beta has slightly better performance.
- Be especially cautious of reliability issues, because the commercial and military markets differ widely. There are solutions, but they may require extra innovation.

ENDNOTES

1."Firms Exit Military Chip Arena" (*Defense News*, August 28, 1995). Semiconductor Industry Association data as reported by Pat Cooper and Phillip Finnegan.

2. DoD data from *National Defense Budget Estimates for FY 1995*, p. 85. Industry data from the National Science Board, Science and Engineering Indicators-1995, p. 332.

3. Kaminski, Dr. Paul G., *Dual Use Technology: A Defense Strategy for Affordable, Leading-Edge Technology* (DoD unnumbered publication, February 1995), preface.

4. Malone, Michael S., "Chips Triumphant" (*Forbes ASAP*, February 26, 1996), p. 66.

5. Engwall, Richard L., *Designing for Dual-Use Electronics* (Westinghouse Electronic Corporation white paper), p.1.

DSMC NAMES ENLISTED PERSON OF THE YEAR

Photo by Richard Mattox

On January 30, 1997, at a ceremony conducted in Howell Auditorium, DSMC's main Fort Belvoir campus, the College named Air Force Staff Sgt. Phillip Copeland its Enlisted Person of the Year. "Phil" was chosen from among five nominees. Besides the Joint Service Commendation Medal, Phil received an engraved plaque, a $100 savings bond, a $100 gift certificate to the Post Exchange, a 96-hour pass, and a reserved parking space. A popular friend and colleague around the campus, Phil works as a Visual Information Specialist in the DSMC Visual Arts and Press Department, Division of College Administration and Services.